

BIBLIOGRAPHIC COUPLING : AN EMPIRICAL STUDY OF ECONOMICS

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The concept of bibliographic coupling developed by Fano and Kessler is empirically tested in two important sub-disciplines of Economics namely, Monetary Economics and Welfare Economics. All the pertinent research papers in these two sub-disciplines from two journals viz; 'American Economic Review' and 'The Economic Journal' over a period of ten years have been culled and 45 pairs have been established to ascertain the coupling strength. The study shows that though there are slightly fewer number of citations in the journal 'American Economic Review', the coupling strength is higher and consistent than 'The Economic Journal'. The tendency of researchers to refer or cite the relevant literature of the immediate past was also observed. This may be due to the fact that either the literature become out of date very quickly or the researchers may not be able to keep track of the entire literature that are being published in a particular discipline, though there are a few exceptions in the case of certain classic and outstanding research papers which are cited frequently. The coupling rate of the citations in American Economic Review has been found to be greater than The Economic Journal.

INTRODUCTION

Citation indexing has become a popular device for retrieval and searching of scientific literature in a field of research. Citation indices are providing information scientists with useful materials for studying literature patterns, information generation, propagation, etc. All such activities are based on the hypothesis that between a citing item and cited set of items, there is a cognitive relationship linkage of some form. The underlying philosophy is that the citing item makes use of some piece of information contained in the cited items for some purpose relevant to the context and content of it.

One of the techniques frequently used in bibliometrics is citation analysis and during the last three decades there has been a burgeoning work in this area. A systematic citation study helps in measuring the degree of interaction among the researchers.

One of the major concepts of bibliometrics is *bibliographic coupling* which occurs when two research papers cite one or more common papers in their works. Fano [1] and Kessler [2] independently suggested that if two different documents referred to a common document, then they should have some sort of proximity or similarity in their approach or study. If the number of common citations for two different papers be multiple rather than single, their strength of coupling is said to be more, implying that their cognitive contents are much closer to each other. Kessler [3,4] in a series of papers had further tried to establish the usefulness of this idea.

The notion of bibliographic coupling and its subsequent works have attracted attention of experts in bibliometrics and information analysis as an interesting area but have hardly taken off the ground. Martyn [5] states that "the main criticism is against the hypothesis that a common parental citation may be considered enough to ensure cognitive relationship". Sen and Gan [6] felt that the idea of bibliographic coupling should be theoretically elaborated and a general mathematical framework be evolved. Sharada and Sharma [7] recently carried out a study of bibliographic coupling in linguistic research by comparing the research papers published in an Indian journal *vis-a-vis* an American journal. In the present paper, an attempt is made to study the bibliographic coupling strength in the field of Economics.

METHODOLOGY

The idea of bibliographic coupling was developed by M.M. Kessler in 1955 at the Massachusetts Institute of Technology. He proposed the idea of obtaining a matrix of conditional relevance measure for any two articles in the following ways:

- (a) Establishing the coupling strength by identifying the common citations given in two papers, x_i and x_j in any field m and denoting this coupling strength by $m(x_i \cap x_j)$
- (b) Denoting the number of citations given in each of the articles x_i and x_j by $m(x_i)$ and $m(x_j)$ respectively;
- (c) The bibliographic coupling strength between two papers, i.e.

P_{ij} is defined as $m(x_i \cap x_j) / m(x_i)$

and $m(x_i \cap x_j) / m(x_j)$

A modified version of Kessler's formula is proposed here for measuring the strength of bibliographic coupling between two papers which is as follows:

Let i and j be two papers from any field. Let n_i , n_j and r_{ij} refer to the number of citations in the papers i , j and the number of citations that are common to both i and j respectively. The bibliographic coupling strength or the coupling index T_{ij} is given by the formula

$$T_{ij} = \frac{r_{ij}}{[n_i \times n_j]^{1/2}} \quad (1)$$

For the comparison of two or more sets of documents on different topics on the basis of their citations and also the bibliographic coupling, the following procedure is suggested.

Let there be N articles in a set and let n_i be the number of citations in i th articles, where $i = 1, 2, 3, \dots, N$. The minimum and maximum number of citations per articles are found, in addition to the average and standard deviations.

The mean or average of citations is given by

$$\bar{x} = \sum_{i=1}^N n_i / N \quad (2)$$

The standard deviation, which is a measure of variability in the data is given by

$$\alpha = \sqrt{\sum_{i=1}^N \frac{(n_i - \bar{x})^2}{(N - 1)}} \quad (3)$$

Different sets of documents can be compared by evaluating and comparing these statistics.

The bibliographic coupling strength T_{ij} can be computed for every pair in the set with the help of (1) for each of the n_{c_2} where n_{c_2} is the number of combinations of any two documents in a set of N documents.

SAMPLE

For this study, two journals, namely, American Economic Review and The Economic Journal published by the American Economic Association (U.S.A.) and the Royal Economic Society (U.K.) respectively have been chosen. Research papers belonging to two sub-disciplines of Economics—'Welfare Economics' and 'Monetary Economics' have been culled out from these two journals.

In each of these two areas ten research papers have been selected from each journal, thus, leading to a total of 40 research papers (Tables 1 and 2).

Table 1

List of articles selected for bibliographic coupling

Subject : Monetary Economics

(a) Name of the Journal : The Economic Journal

Sl.no.	Author	Title	Vol. & Issue no.	Year	No. of citations
1.	Anderson, R.W. & Danthine, J.P.	Higher diversity in future markets	93 (370)	1983	32
2.	Djajic, S.	Currency management & economic stability	94 (374)	1984	29
3.	Marini, G.	Intertemporal substitution and the role of monetary policy	95 (377)	1985	20
4.	Cuddington, J.T. & Vinals, J.M.	Budget deficits and the current account in the presence of classical unemployment	96 (381)	1986	30
5.	Dornbush, R.	Exchange rate economics: 1986	97 (385)	1987	43
6.	Fisher, S.	Recent developments in economics	98 (391)	1988	259
7.	Svensson, L.E. & Wijabergen, S.V.	Excess capacity, monopolistic competition, and international transmission of monetary disturbances.	99 (397)	1989	22
8.	Jansen, D.W.	International substitution and the role of monetary policy: policy irrelevance once again	100 (401)	1990	18
9.	Miller, M, & Weller, P.	Exchange rate bands with price inertia	101 (409)	1991	38
10.	Lee, K.C., Pesaran, M.H. & Pierse, R.G.	Persistence of shocks and their sources in a multi-sectoral model of UK output growth	102	1992	28

(Contd.)

Table 1 (..Contd.)

(b) Name of the Journal : American Economic Review

Sl. no.	Author	Title	Vol. & Issue no.	Year	No. of Citations
1.	Bradford, C.	The money supply announcement puzzle: review & interpretation	73 (4)	1983	30
2.	King, R.G. & Plosser, C.I.	Money, credit and prices in a real business cycle	74 (3)	1984	38
3.	Aizemman, J. & Frankel, J.A.	Optimal wage indexation: foreign exchange intervention and monetary policy	75 (3)	1985	27
4.	Evans, G	A test for speculative bubbles in the Sterling-Dollar exchange rate-1981-84.	76 (4)	1986	48
5.	Frankel, J.A. & Froot, K.A.	Using survey data to test standard proposition regarding exchange rate expectation	77 (1)	1987	33
6.	Boyle, W.G. & Young, K.A.	Asset prices, commodity prices and money : a general equilibrium rational expectation model	78 (1)	1988	28
7.	Froot, K.A. & Klemperer, P.D.	Exchange rate pass-through when market share matters	79 (4)	1989	38
8.	Engel, C. & Hamilton, J.D.	Long swings in the Dollar: are they in the data and do the markets know It?	80 (4)	1990	48
9.	Alogoskoufis, G.S. & Smith, R.	The Phillips Curve, the persistence of inflation and the lucas critique: evidence from exchange rate regimes	81 (5)	1991	49
10.	McLeod, D.W.B & Malcomson, J.M.	Investments, holdup and the form of market	83 (4)	1993	42

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Table 2

*List of articles selected for bibliographic coupling***Subject : Welfare Economics**

(a) Name of the journal : The Economic Journal

Sl. no.	Author	Title	Vol. & Issue no.	Year	No. of citations
1.	Gordon, R.J.	Why U.S. wage and employment behaviour differs from that in Britain & Japan	92 (365)	1982	60
2.	Kennally, G.F.	Some consequences of opening a Neo-Keynesian model	93 (370)	1983	23
3.	Kooiman, P.	Smoothing the aggregate fix-price model and the use of business survey data	94 (376)	1984	26
4.	Evans, G.	Bottlenecks and the Phillips Curve: a disaggregate Keynesian model of inflation, output & unemployment	95 (378)	1985	25
5.	Matusz, S.J.	Implicit contracts, unemployment and international trade	96 (382)	1986	21
6.	Newbery, M.D. & Stiglitz, J.E	Wage rigidity, implicit contracts, unemployment and economic efficiency	97 (386)	1987	14
7.	Burgers, S.M.	Employment adjustment in U.K. manufacturing	98 (389)	1988	29
8.	Dowrick-Steve	Union-oligopoly bargaining	99 (398)	1989	37
9.	Nickell, S.	Unemployment: a survey	100 (401)	1990	262
10.	Hendricks, W.E. & Kahn, L.M.	Efficiency wages, monopoly unions and efficient bargaining	101 (408)	1991	25

(Contd.)

Table 2 (..Contd.)

(b) Name of the journal : American Economic Review

Sl. no.	Author	Title	Vol. & Issue No.	Year	No. of citations
1.	Bull, C.	Implicit contracts in the absence of enforcement and risk aversion	73 (4)	1983	25
2.	Miyazaki, H.	Internal bargaining, labour contracts and a Marshallian Theory of the firm	74 (3)	1984	25
3.	Shultz, C.L.	Micro economics efficiency and nominal wage stickiness	75 (1)	1985	39
4.	Kahneman, D., Kuetsch, J.M. & Thaler, R.	Fairness as a constraint on profit seeking; entitlements in the market	76 (4)	1986	31
5.	Abowd, J.M. & Card, D.	Intertemporal labour supply long-term employment contracts	77 (1)	1987	32
6.	Arnott, R., Hosios, A.J. & & Stiglitz, J.	Implicit contracts, labour mobility and unemployment	78 (5)	1988	32
7.	Brown, J.N.	Why do wages increase with tenure? On the job training and life-cycle wage growth observed within firms	79 (5)	1989	31
8.	Card, D.	Unexpected inflation, real wages and employment determinations in union contracts	80 (4)	1990	37
9.	Currie, J & McConnell S.	Collective bargaining in public sector: the effect of legal structure on disputed costs & wages	81 (4)	1991	38
10.	Crampton, P.C. & Tracy, J.S.	Strikes and hold-outs in wage bargaining: theory	82 (1)	1992	25

From each set all the ten articles are considered in pairs and, thus, leading to 45 pairs. For every pair, x_i , x_j and T_{ij} were noted and calculated. The

details of these citations and couplings are given in Tables 3, 4, 5 and 6. Thereafter, the coupling index has been calculated using the formula (1).

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Table 3

Bibliographic coupling in Monetary Economics

(a) Name of the journal :The Economic Journal

Sl. no.	Couple	N _i	N _j	R _{ij}	T _{ij} = [R _{ij} / √N _i N _j]
1	1, 2	32	29	0	0
2	1, 3	32	20	0	0
3	1, 4	32	30	0	0
4	1, 5	32	43	0	0
5	1, 6	32	259	0	0
6	1, 7	32	22	0	0
7	1, 8	32	18	0	0
8	1, 9	32	38	0	0
9	1,10	32	28	0	0
10	2, 3	29	20	0	0
11	2, 4	29	30	2	0.07
12	2, 5	29	43	1	0.028
13	2, 6	29	259	0	0
14	2, 7	29	22	0	0
15	2, 8	29	18	0	0
16	2, 9	29	38	2	0.06
17	2, 10	29	28	0	0
18	3, 4	20	30	0	0
19	3, 5	20	43	0	0
20	3, 6	20	259	4	0.056
21	3, 7	20	22	0	0
22	3, 8	20	18	0	0
23	3, 9	20	38	7	0.25
24	3, 10	20	28	0	0
25	4, 5	30	43	0	0
26	4, 6	30	259	2	0.022
27	4, 7	30	22	3	0.12
28	4, 8	30	18	0	0
29	4, 9	30	38	0	0
30	4, 10	30	28	0	0
31	5, 6	43	259	1	0.009
32	5, 7	43	22	2	0.065
33	5, 8	43	18	0	0
34	5, 9	43	38	2	0.049
35	5, 10	43	28	0	0
36	6, 7	259	22	4	0.052
37	6, 8	259	18	5	0.052
38	6, 9	259	38	0	0.07
39	6, 10	259	28	3	0.035
40	7, 8	22	18	0	0
41	7, 9	22	38	0	0
42	7, 10	22	28	0	0
43	8, 9	18	38	0	0
44	8, 10	18	28	0	0
45	9, 10	38	28	0	0

Table 4

Bibliographic coupling in Monetary Economics

(b) Name of the journal : American Economic Review

Sl. no.	Couple	N _i	N _j	R _{ij}	T _{ij} = [R _{ij} / √N _i N _j]
1	1, 2	30	38	2	0.06
2	1, 3	30	27	0	0
3	1, 4	30	48	1	0.026
4	1, 5	30	33	1	0.031
5	1, 6	30	28	2	0.07
6	1, 7	30	38	0	0
7	1, 8	30	48	1	0.026
8	1, 9	30	49	0	0
9	1, 10	30	42	0	0
10	2, 3	38	27	2	0.06
11	2, 4	38	48	0	0
12	2, 5	38	33	0	0
13	2, 6	38	28	2	0.06
14	2, 7	38	38	0	0
15	2, 8	38	48	0	0
16	2, 9	38	49	1	0.023
17	2, 10	38	42	1	0.025
18	3, 4	27	48	1	0.027
19	3, 5	27	33	0	0
20	3, 6	27	28	0	0
21	3, 7	27	38	0	0
22	3, 8	27	48	0	0
23	3, 9	27	49	0	0
24	3, 10	27	42	2	0.06
25	4, 5	48	33	5	0.125
26	4, 6	48	28	1	0.027
27	4, 7	48	38	0	0
28	4, 8	48	48	4	0.083
29	4, 9	48	49	2	0.041
30	4, 10	48	42	0	0
31	5, 6	33	28	0	0
32	5, 7	33	38	1	0.028
33	5, 8	33	48	5	0.125
34	5, 9	33	49	0	0
35	5, 10	33	42	0	0
36	6, 7	28	38	0	0
37	6, 8	28	48	0	0
38	6, 9	28	49	3	0.08
39	6, 10	28	42	0	0
40	7, 8	38	48	1	0.023
41	7, 9	38	49	0	0
42	7, 10	38	42	0	0
43	8, 9	48	49	0	0
44	8, 10	48	42	0	0
45	9, 10	49	42	1	0.022

Table 5

Bibliographic coupling in Welfare Economics

(a) Name of the Journal: The Economic Journal

Sl. no.	Couple	N _i	N _j	R _{ij}	$T_{ij} = [R_{ij} / \sqrt{N_i N_j}]$
1	1, 2	60	23	2	0.054
2	1, 3	60	26	2	0.051
3	1, 4	60	25	5	0.13
4	1, 5	60	21	5	0.14
5	1, 6	60	14	3	0.10
6	1, 7	60	29	0	0
7	1, 8	60	37	0	0
8	1, 9	60	262	7	0.056
9	1, 10	60	25	0	0
10	2, 3	23	26	3	0.122
11	2, 4	23	25	4	0.167
12	2, 5	23	21	0	0
13	2, 6	23	14	0	0
14	2, 7	23	29	0	0
15	2, 8	23	37	0	0
16	2, 9	23	262	0	0
17	2, 10	23	25	0	0
18	3, 4	26	25	3	0.12
19	3, 5	26	21	0	0
20	3, 6	26	14	0	0
21	3, 7	26	29	0	0
22	3, 8	26	37	0	0
23	3, 9	26	262	0	0
24	3, 10	26	25	0	0
25	4, 5	25	21	0	0
26	4, 6	25	14	0	0
27	4, 7	25	29	0	0
28	4, 8	25	37	0	0
29	4, 9	25	262	5	0.06
30	4, 10	25	25	0	0
31	5, 6	21	14	4	0.23
32	5, 7	21	29	0	0
33	5, 8	21	37	0	0
34	5, 9	21	262	5	0.067
35	5, 10	21	25	0	0
36	6, 7	14	29	0	0
37	6, 8	14	37	0	0
38	6, 9	14	262	7	0.12
39	6, 10	14	25	0	0
40	7, 8	29	37	3	0.09
41	7, 9	29	262	7	0.08
42	7, 10	29	25	2	0.07
43	8, 9	37	262	4	0.04
44	8, 10	37	25	6	0.197
45	9, 10	262	25	7	0.086

Table 6

Bibliographic coupling in Welfare Economics

(b) Name of the Journal: American Economic Review

Sl. no.	Couple	N _i	N _j	R _{ij}	$T_{ij} = [R_{ij}/\sqrt{N_i \times N_j}]$
1	1, 2	25	25	4	0.16
2	1, 3	25	39	5	0.16
3	1, 4	25	31	2	0.07
4	1, 5	25	32	3	0.11
5	1, 6	25	32	6	0.21
6	1, 7	25	31	2	0.07
7	1, 8	25	37	0	0
8	1, 9	25	38	0	0
9	1, 10	25	45	0	0
10	2, 3	25	39	5	0.16
11	2, 4	25	31	2	0.07
12	2, 5	25	32	2	0.07
13	2, 6	25	32	3	0.11
14	2, 7	25	31	0	0
15	2, 8	25	37	3	0.099
16	2, 9	25	38	0	0
17	2, 10	25	45	0	0
18	3, 4	39	31	3	0.086
19	3, 5	39	32	5	0.14
20	3, 6	39	32	4	0.11
21	3, 7	39	31	1	0.028
22	3, 8	39	37	3	0.08
23	3, 9	39	38	0	0
24	3, 10	39	45	0	0
25	4, 5	31	32	3	0.09
26	4, 6	31	32	2	0.06
27	4, 7	31	31	0	0
28	4, 8	31	37	0	0
29	4, 9	31	38	0	0
30	4, 10	31	45	0	0
31	5, 6	32	32	4	0.125
32	5, 7	32	31	1	0.03
33	5, 8	32	37	3	0.087
34	5, 9	32	38	0	0
35	5, 10	32	45	0	0
36	6, 7	32	31	0	0
37	6, 8	32	37	1	0.029
38	6, 9	32	38	0	0
39	6, 10	32	45	0	0
40	7, 8	31	37	0	0
41	7, 9	31	38	0	0
42	7, 10	31	45	0	0
43	8, 9	37	38	2	0.053
44	8, 10	37	45	1	0.024
45	9, 10	38	45	2	0.048

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The statistical details pertaining to 'Monetary Economics' and 'Welfare Economics' have been ascertained individually for two journals. Table 7 gives a compendious picture of the statistical parameters which *inter alia*, give details for each subject the

minimum, maximum and average number of citations. The range of citations among the ten research papers and the dispersion of citations are measured with the help of standard deviation and mean deviation.

Table 7

Parameter patterns of citations per article

Journal	Statistical parameters	Subjects	
		Monetary Economics	Welfare Economics
The Economic Journal	Minimum citations	18.00	14.00
	Maximum citations	259.00	262.00
	Average citations	51.90	52.20
	Standard deviation	73.17	74.75
	Range	241.00	248.00
	Mean deviation	41.42	43.52
American Economic Review	Minimum citations	28.00	25.00
	Maximum citations	49.00	45.00
	Average citations	38.10	33.50
	Standard deviation	8.48	5.74
	Range	21.00	20.00
	Mean deviation	6.93	4.70

Since some of the papers do not have common citations, a coupling rate is arrived at for each sub-discipline, separately, for both the journals by using the formula

$$\text{Coupling Rate (Cr.)} = \frac{\text{No. of pairs having common citations}}{\text{Total No. of pairs}} \times 100$$

After calculating the coupling index for each pair, minimum, maximum and average indices were calculated for each sub-discipline in both the journals. These details are exhibited in Table 8.

ANALYSIS

It would be obvious from Table 7 that research papers from 'The Economic Journal' tend to give more

number of average citations per paper than 'American Economic Review'. This has been due to the fact that in both the sub-disciplines of 'The Economic Journal' there has been a survey article which has reviewed the literature pertaining to both the sub-disciplines quite extensively, resulting in the high rate of average citations. The table also shows that the minimum number of citations appear in 'The Economic Journal' itself.

Further, the range of citations in all the four sets of research papers shows that there has been quite a huge range among the articles of 'The Economic Journal'. The range of papers appearing in 'American Economic review' is quite negligible.

When the subjects are compared, the trends are more or less same for both the journals. This is

due to the fact that both the sub-disciplines play an equally important role in the field of Economics (Table 8).

From Table 8, it is quite clear that the coupling rate is slightly higher for the journal 'American Economic Review' than 'The Economic Journal'. In both the sub-disciplines the rate of coupling has been higher for 'American Economic Review' than

'The Economic Journal'. There has been a high rate of 55.55% coupling in *welfare economics* and a low rate of 28.88% in *monetary economics*. A sharp contrast was noticed here, that though there are more number of citations in 'The Economic Journal' there has been a low rate of coupling exhibited among the citations of various pairs of research papers.

Table 8

Bibliographic coupling

Journal	Subjects				
	Monetary Economics		Welfare Economics		
	Bibliographic coupling index	Coupling rate	Bibliographic coupling index	Coupling rate	
The Economic Journal	Maximum	0.25	28.88%	Maximum	0.23
	Minimum	0.009		Minimum	0.04
	Average	0.068		Average	0.103
American Economic Review	Maximum	0.125	44.44%	Maximum	0.21
	Minimum	0.022		Minimum	0.024
	Average	0.051		Average	0.091

Another interesting finding of the study is that throughout the citations, bibliographic coupling is observed among the papers of immediate past (Tables 3, 4, 5 and 6) which shows that majority of the researchers tend to refer the most recent literature for their study. It was observed in the study that most of the authors invariably referred to at least a few outstanding and classic research papers pertaining to each sub-discipline. There have been a few notable contributors like Azardio Costas, Barro Robert, Baily Martin in the field of *welfare economics* and Rudiger Dornbush, Robert Lucas, Stanley Fisher, Jeffery Frankel, Kenneth Froot and James Tobin in the field of *monetary economics* whose research papers have been frequently cited.

CONCLUSIONS

The following observations can be drawn from this study :

- (1) There has been very little to choose between the two journals from the point of view of number of citations, though the average citations are greater in 'The Economic Journal' due to the presence of survey articles. In fact, both the journals cite more or less in a similar fashion. The variability is less for 'American Economic Review' than 'The Economic Journal'. This is amply evidenced by the presence of high coupling rate in the journal ('American Economic Review').

- (2) There have been a marginally higher number of citations in the discipline of *monetary economics* than *welfare economics*.
- (3) A higher rate of coupling has been observed in the discipline of *welfare economics* than *monetary economics* in both the journals.
- (4) Comparatively, a higher rate of variation can be observed in the discipline of *welfare economics* of 'The Economic Journal' and that of *monetary economics* in 'American Economic Review' .
- (5) The range of citations is larger in the case of 'The Economic Journal' than 'American Economic Review' .

Bibliographic coupling provides to a great extent the relationship between a set of research papers pertaining to a field. This will certainly help the information seekers in searching the document and to a certain extent help in classifying the information.

It would be possible for a researcher to cover the area of his interest more comprehensively and systematically by referring to research papers having high coupling strength. Coupling index may also come in handy to compile special bibliographic materials.

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